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ABSTRACT

This paper introduces and gives a report of the first of a series of studies concerned with the developmental aspects of information processing. The experiments are concerned chiefly with how repeated visual encounters influence infants' attentional preference for what is familiar or unfamiliar and how infants' preference can be affected by responsiveness to the infants' spontaneous efforts. In the first exploratory study of the series, two stimulus patterns were placed over the cribs of 15 infants for the infants to look at and be familiar with. One pattern was stationary and one moved. Following 4 to 5 weeks of exposure, each baby's preference for one of the patterns was assessed. Next, each of the familiar patterns was presented simultaneously with an unfamiliar one and then reversed, and a record of the direction of the infant's gaze was kept. Results favored the hypothesis of attentional preference for the familiar pattern. The general strategy used in this study is to be further refined in the author's subsequent studies. (DR)

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ATTENTIONAL PREFERENCE AND EXPERIENCE: I. INTRODUCTION[1]

by

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Most of what we think we know about intelligence, learning, memory, perception, and thinking is based upon human subjects responding to pictorial, vocal, and graphic symbols for concrete, three-dimensional objects. Is it not therefore ironic, Sigel (34) asks, and I paraphrase his question, that we know so little about the development of the information processing in the perceptual and manipulative encounters with concrete reality giving rise to the central-process codes which permit recognition of the concrete, of its representations, and of symbols for it? Ultimately, these central-process codes permit the operations of thought. This series of papers reports a sequence of experiments concerned with one of the earliest developmental aspects of information processing. It is concerned chiefly with how repeated visual encounters with objects or patterns influence attentional preference for what is familiar and what is unfamiliar or novel. Secondarily, certain of the studies are concerned also with what responsiveness to an infant's spontaneous efforts contributes to attentional preference.

This series of investigations began in 1962 when several informal lines of evidence had suggested (18,19) that, under at least certain conditions, perceptual encounters with objects, patterns, persons, and places, lead to attentional preference for these familiar objects, patterns, etc., before they lead to preference for what is unfamiliar or novel. One of these lines of evidence resides in the observed phenomena -- as distinct from their theoretical interpretation -- of what Lorenz (27) has termed "imprinting." Although Lorenz emphasized his theory of instincts with their perceptual "releasers," it appeared to me to be objects repeatedly encountered through visual, and perhaps also auditory, perception for which young birds and mammals have been observed to show the attentional preference implied in the following response. Although Hess (17) has reported evidence that the percentage of choices of the imprinted model in his tests is a function of how far the bird has followed the model during the imprinting encounters (his "law of effort"), all imprinting procedures appear to involve periods of looking at the object to be imprinted, and often listening to sound from it as well, before the following response occurs. Thus, it would appear that it is motivation from recognitive familiarity which initiates the following, and then becomes combined with the effects of association with feeding, with comfort contact (13), and/or with effort (10,17), to produce the emotional attachment or cathexis manifested in a predominance of choices for the imprinted model over other objects. Such considerations, however, fall outside the scope of this series of investigations.

A second suggestive line of evidence derives from Piaget's (31) observations of his own children. Although Piaget avowedly concerned himself only with the development of intelligence, such a statement as "the more objects the child sees the more new ones he wishes to see" (31, p. 277) constitutes a motivational principle. As I have pointed out elsewhere (18, 19), moreover,

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Piaget's observations suggest the existence of an epigenesis not only of intelligence but also of that form of motivation inherent in information processing and action. At the first stage of this epigenesis, human infants appear to begin by being responsive chiefly to changes in the characteristics of ongoing receptor inputs through the eyes and the ears. A second stage in the epigenesis of such motivation begins with the appearance of intentional activities calculated to prolong or elicit interesting spectacles. These also mark the onset of Piaget's Stage III in sensorimotor intelligence. Examination of Piaget's reported observations suggests that the patterns which elicit these intentional activities are those which have been repeatedly encountered, e. g., human faces, toys strung over the bassinet, or even the newspaper which Piaget placed repeatedly on the cover of his son's bassinet. One may consider these activities to be intentional because the infant's behavior implies an anticipation of the perceptual outcome of his actions. The earliest of these intentional activities appears to derive from repeatedly-encountered contingencies between these actions and their perceptual outcomes. These merge gradually into what Piaget called pseudo-imitation of those familiar activities already established within an infant's repertoire. A third stage of this epigenesis in such motivation begins with interest in unfamiliar or novel patterns. Whether this interest in the novel comes as a matter of maturation is still quite unclear. As I have suggested elsewhere (19), a transition to a stage-like, generalized interest in the novel may possibly come about on a basis other than mere maturation. Learning to recognize through repeated perceptual encounters a substantial number and variety of objects, persons, patterns, and situations, may lead to the achievement of a kind of generalized expectation that "things should be recognizable." Such a generalized expectation could well develop after the fashion of Harlow's (13) "learning sets." With the achievement of such a set, seeing or hearing unrecognizable patterns might well come to evoke prolonged looking or listening on the basis of a task-like motive to make recognizable sense out of a somewhat strange source of input. At any rate, according to Piaget's observations, the development of an interest in the novel is followed by, and perhaps brings about, the onset of genuine imitation of unfamiliar and novel models which regularly comes after the pseudo-imitation of familiar models.

A third suggestive line of evidence comes from the behavior of young children toward television. Nothing is more boring to adults than the repeatedly-encountered commercials. Yet many mothers have noted that their young children often get up and leave what they have been doing when they hear the sounds of a familiar commercial on the set. When the commercial ends, moreover, the children revert to the activity which they had left to look at the television. In view of their own boredom with the repetitive commercials, mothers are typically puzzled by this manifestation of interest in commercials shown by their young children. This is but a casual observation, yet it gets support from the formal investigations of Friedlander and his students (personal communication). Infants in their second year who are provided with a choice between a highly redundant and a less redundant auditory message in Friedlander's Playtest regularly, at first, press the lever which brings longer listening time for the redundant message than for the less redundant message. Later, following more encounters, they come to press more frequently the lever which brings longer listening time for the less redundant pattern than for the more redundant one.

Fourth, such evidence appears to be both related to and consonant with Hebb's conception of the relation of pleasure to memory where he says that "from this theoretical point of view, one would find behavior dominated always by the thought process that is not fully organized -- one that is achieving a new organization or one in which synaptic decay makes it necessary that organization be reachieved" (16, p. 229). Thus, to put the hypothesis in other words, attentional preference may be expected to go to objects and patterns and places which have been perceived just often enough to develop central processes which permit tentative recognition, and, with more perceptual encounters, attentional preference should shift to what is unfamiliar or novel.

Just before this series of studies began and while they have been underway, a number of investigators got several telling findings concerning the information-processing of young infants. Contrary to the long traditional view that pattern vision is wanting during the earliest weeks following birth, Berlyne (2, 3) and Fantz (7) both demonstrated clearly the existence of selective visual attention in very young infants, even in the newborn, favoring patterned surfaces over relatively homogeneous ones. While the human eye has been shown to have little capacity for accommodation at birth (15) and is essentially a fixed-focus camera with vision clearest at approximately 25 centimeters from the cornea, infants rapidly acquire accommodative skill with looking (11). Moreover, while acuity at ages under one month has been found to be limited to a minimum separable visual angle of 40 seconds, it improves rapidly during the first half year to a minimum separable visual angle of about 10 seconds (9). Clearly, the visual system is ready for impressions at birth in human infants.

How visual exploration and experience alter the information processing involved in visual attention, visual exploration, perception, memory and recognition, and thought has also come under new kinds of investigation. It so happens that just as the exploratory findings from our laboratory appeared to support the hypothesis that repeated perceptual encounters do lead to a phase in which attentional preference, as assessed by looking time, goes to the familiar one rather than to the unfamiliar one of paired patterns, various other investigators of attentional preference and experience began reporting that infants and young children are attracted by and look longer at what is unfamiliar or novel (1, 4, 5, 6, 8, 21, 23, 24, 25, 26, 28, 30, 32). Investigators have also reported that the tendency to prefer unfamiliar or novel patterns over those which are familiar increases with age in children (6, 24, 33).

While certain investigators have limited their evidence of attentional preference to the time infants devote to looking at the visual patterns which are either familiar or unfamiliar to them, other investigators have supplemented this evidence with that of deceleration in the heart rate (21, 26, 28, 30). Such cumulative evidence for attentional preference for unfamiliar inputs over familiar ones combined with recognizable defects in the experiments to be reported in this series led us to withhold publication until the accumulating evidence coupled with a theoretical distinction produced a level of confidence justifying publication.

The general strategy of the experiments in this series has been to place patterns (sometimes one and sometimes two) over the cribs of infants beginning when they were about four weeks old, and then to test the attentional preference of the infants for these familiar patterns by presenting them simultaneously in pairings with patterns which were unfamiliar or novel. Following another period of familiarization, the test of attentional preference was repeated.

In the first exploratory study (20), two stimulus patterns were placed over the cribs for the infants to look at and become familiar with. One of these patterns was stationary. The other was intended to be "responsive"; it was attached to a pole that clamped to the infant's crib so that his movements might produce movement in the pattern. Following four to five weeks of exposure to the two patterns, each baby's preference for one of them was assessed by obtaining a record of the time that the baby spent looking at each of them over a five-minute cumulative period of looking at one or the other. Following this, each of the familiar patterns was presented simultaneously with an unfamiliar one, and a record of the direction of the infant's gaze was kept until he had accumulated a total of four minutes of looking time at one or the other, with the sides reversed after the first two minutes of looking time had accumulated.

This initial exploratory study utilized three kinds of patterns, each of which was potentially a mobile. Each one consisted of a base which was either an equilateral triangle with five-inch sides or a circle with a five-inch diameter. These bases were painted either yellow or red. They were attached by means of three wires to a horizontal metal bar extending from either the stand that rested on the floor or the vertical pole attached to the crib. From each base hung three dangles on three-inch strings. For one pattern, these dangles consisted of yarn tassels. On the outside these tassels were composed of such neutral-colored yarns as gray-green, medium brown, and grayish-blue, while the centers were of bright-colored yarn such as yellow-orange, red, or bright green. For the second kind of pattern the dangles consisted of three match boxes covered with bluish, greenish, and pink wrapping paper. Print was present but not prominent on the covering papers of two. Each box presented a rectangular shape to the infant of about the same size as the yarn tassels. For the third pattern, the dangles consisted of three open, paper umbrellas with small flowers painted without prominence on two of them.

The results, obtained after approximately a month of familiarization when the infants were approximately two months old from comparing the durations of looking at the familiar pattern while it was paired with an unfamiliar one, appeared strongly to favor the hypothesis of attentional preference for the familiar pattern. A total of 21 infants completed the four or five weeks of familiarization, but 6 had to be dropped because of side-preference rather than pattern preference. Of the 15 infants from whom analyzable records were obtained, 12 looked longer at each familiar pattern (both the preferred one and the non-preferred one) than at the unfamiliar one. None of the 15 failed to look longer at one of the two familiar patterns than at the unfamiliar one. The 27 familiar-unfamiliar ratios ranged in size from 129/111 to 23/1, but only 9 were less than 3/1.[2]

The strength of this empirical support for the hypothesis of attentional preference for the familiar pattern may appear to be stronger than it really is. While the patterns with yarn dangles, box dangles, and umbrella dangles were employed in each of the three experimental conditions of stable-familiar, responsive-familiar, and unfamiliar patterns, they did not appear equally often in these roles. Even though an attempt was made to have patterns of equal attractiveness, the umbrella dangles proved to be less attractive than either the yarn dangles or the box dangles. Moreover, 9 of the 15 babies with analyzable records got the umbrella dangles as their unfamiliar pattern, so the effects of recognitive familiarity on attentional preference could well be seriously exaggerated here through confounding with pattern attractiveness. These defects prompted another exploratory study (36) which would more adequately counterbalance the roles of the patterns employed and which would be longitudinal in character by repeating the period of familiarization and the tests of attentional preference.

As evidence from this series of studies for the existence of an early phase of attentional preference for the familiar over the unfamiliar has accumulated, simultaneously growing evidence for a distinction between short-term memory and long-term memory (29) suggested both a scrutiny of the various bits of evidence for attentional preference for the unfamiliar and a theoretical distinction between perceptual satiation and perceptual habituation. All but two of the studies reporting attentional preference for the novel that are known to me have been cross-sectional in character. They have not repeatedly tested the attentional preference of the same infants after various durations of exposure to patterns becoming recognitively familiar. One may assume, therefore, that these investigators can well have missed that phase of their infant subjects' interaction with the various test-patterns in which attentional preference for the familiar might have been manifest. These two exceptions call for special attention. Within such a brief experimental period as 10 minutes, Fantz (8) has reported that successive minutes of perceptual contact with a given pattern presented simultaneously with another which changes from minute to minute leads very young infants to look a greater and greater proportion of the successive minutes at the unfamiliar patterns encountered for the first time. The study by Saayman, et al. (32) also concerns the effects of essentially continuous perceptual contact with a pattern over the duration of a single experimental session. Thus, one may say that in the course of either continuous, or essentially continous, perceptual contact with an object or a pattern something like perceptual satiation occurs. It was partially from such evidence that I originally inferred (18, 19) that the stimuli which are probably effective during the earliest weeks following birth in attracting attention and in evoking the arousal aspects of the orienting response (35) consist of changes in the various characteristics of on-going inputs. Such preference for the novel might well be based upon perceptual satiation which may well take place before the perceptual encounter has produced enduring central-process codings within the central nervous system required for recognition at another time (long-term memory). Thus, quite different results might be expected from repeated perceptual encounters with objects of patterns which are separated by periods of considerable time. Such intermittent perceptual encounters must gradually

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establish central-process codings which permit recognition of the patterns, and perhaps it is only as such recognition is emerging that attentional preference goes to the repeatedly-encountered pattern over the never-encountered pattern. Perhaps, moreover, it is only after such recognition has become well-established that attentional preference and interest shift from the repeatedly-encountered pattern to one which has never been encountered. Such an interpretation is little more than an application of Hebb's conception of the relation of pleasure to memory already mentioned above. To put the hypothesis with which this series of experiments is mainly concerned in yet other words, attentional preference presumably goes to objects and patterns which have been perceived just often enough to develop central processes which permit tentative recognition.[3]

The second (36) and third (12) papers in this series employ the general strategy outlined above with substantial refinements. The fourth (22) employed various changes in the conditions which appear to have obscured the evidence, and the fifth (37) has employed a change of methodology which appears clearly to have established the existence of attentional preference for patterns which are emerging into recognitive familiarity. None of these first five studies attempts to clarify whether this phase of attentional preference for the familiar is one of maturation <u>per se</u>, or is a phase of an organism's informational interaction with patterns in general. This latter issue is being investigated in a study by Paraskevopoulos and Hunt with yet other modifications in methodology.

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FOOTNOTES

1. This series of studies has been part of the program of research supported by the following grants from the United States Public Health Service: K6-MH-18567, MH-08468, and MH-11321.

2. It is a matter of luck that this empirical support for the role of familiarity in attentional preference was obtained, for even though Piaget's observations helped suggest this series of experiments, they also led me astray. Since Piaget had observed the intentional behavior implying the attractiveness of familiar objects only after his own children were about four months old, I considered it very unlikely that the behavioral evidences of attentional preference for the familiar could become manifest before two or three months of daily perceptual encounters. I therefore discouraged my collaborator, Ina Uzgiris, from making tests of attentional preference as soon as she might have. Had she followed my counsel, the results of this initial exploratory study might have yielded results which would have completely discouraged further effort on this investigative enterprise, and the evidence which appears genuinely to support the existence of a phase of attentional preference for what is becoming recognitively familiar might well have been missed.

3. The motivational tendencies deriving from information processing seldom operate alone. The attachment involved in imprinting, for example, probably results in part from the comfort of contact and cover which Harlow (14) has emphasized, from association with eating, and also from the effort involved in following to which Hess (17) has drawn attention.